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REPORT NO. UMTA-MA-11-0086-81-3

TECHNIQUES FOR IMPROVING COMMUNICATION WITH VISUALLY IMPAIRED USERS OF RAIL RAPID TRANSIT SYSTEMS

EXCERPTS FROM A STUDY ENTITLED

IMPROVING COMMUNICATIONS WITH THE VISUALLY IMPAIRED IN RAIL RAPID TRANSIT SYSTEMS

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16. Abstract

This report presents, in abbreviated form, a compilation of suggestions for making rail rapid transit more accessible to visually impaired travellers. The suggestions are also tied to brief statements of problems faced by these travellers. The format in which these suggestions are presented is that of a hypothetical trip through a rapid rail system.

The suggested methods for improving communications fall within the following categories: 1)signage and other print information; 2)graphic information; 3) auditory information; 4)textural information; 5)special equipment designs; 6)architectural designs; and 7)operating procedures.

This document was prepared as part of a study entitled "Improving Communications with the Visually Impaired in Rail Rapid Transit Systems." A two-volume final report was prepared under that study and the authors have extracted from those two more-detailed volumes the suggestions they recommend for improving communications. This compilation is available from the UMTA Office of Research and Technical Assistance. The final reports are entitled (Vol.I) "Solutions for Problems of Visually Impaired Users of Rail Rapid Transit" and (Vol. II) "Information About Visual Impairment for Architects and Transit Planners." The final-report volumes are available from National Technical Information Service(NTIS).

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METRIC CONVERSION FACTORS

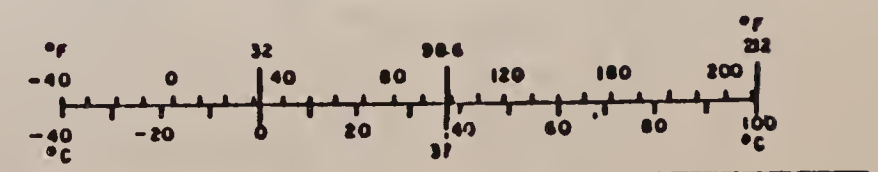
Approximate Conversions to Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.8	kilometers	km
	AREA			
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
	MASS (weight)			
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
	VOLUME			
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
	TEMPERATURE (exact)			
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures. Price $2.25. SD Catalog No. C13.10:286.

Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
	LENGTH			
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
	AREA			
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
	MASS (weight)			
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
	VOLUME			
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
	TEMPERATURE (exact)			
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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INTRODUCTION

This report presents the major findings of a one year study of the problems faced by visually impaired persons who attempt to use rail rapid transit, and of the solutions to these problems. The work was conducted by three principal investigators at Boston College, through contract with the Office of Policy Research, Urban Mass Transportation Administration.

The overall purpose of the study was: 1) to analyze the problems experienced by visually impaired users of rail rapid transit; 2) to identify strategies for remediating these problems, and 3) to suggest methods which would improve communication with these riders.

In order to identify and analyze the problems encountered by visually impaired users of rapid rail, the investigators employed five major procedures:

1) A detailed task analysis of a trip through a rapid rail system was done by an experienced Orientation and Mobility Teacher. This resulted in a sequential list of decisions which must be made by visually impaired travellers in rapid rail facilities. (These decision points all represented potential problems.)

2) A thorough search for, and reading of documents pertinent to the use of rapid rail transit by the visually impaired was accomplished.

3) Three Orientation and Mobility (O&M) Specialists (1 in Atlanta, 1 in Philadelphia, and 1 in Boston) travelled through their local rapid rail systems with 9 blind travellers on an independent basis (total trips = 27). The purpose of these individual trips was to gather first-hand anecdotal records of the problems encountered by each traveller. In order to maintain consistency across travellers, the O&M Specialists followed a script which had been prepared for them, and tape recorded the entire trip.

4) Based on the results of the 27 trips, the literature search, and the task analysis, an interview instrument was designed for use in telephone interviews of a stratified sample of 81 blind subjects. The purpose of these interviews was to gather additional anecdotal data as well as to verify or reinterpret problems already identified.

5) Individual interviews were conducted with 8 O&M Specialists who were familiar with the problems encountered by naive blind travellers in rapid rail systems. These interviews served to further confirm or expand upon the collection of problems which had already been identified.

Approximately 60 problems experienced by visually impaired users of rail rapid transit were identified using these procedures. The problems which were identified were then grouped in a "trip" format, as shown by the following examples:

Requirement: The user must identify the station and locate the entrance.

Problem: There was a lack of consistent signage or architectural clues which could be used to find the entrances of some stations.

Requirement: User must perceive and understand information about the correct platform, train, and direction.

Problem: Some signs were written in small print only. Some signs were poorly lit.

Requirement: User must be able to pass through doors.

Problem: Doors which opened outward and were in the path of travel were dangerous obstacles which could be walked into.

Requirement: The user must identify the desired stop or station.

Problem: There were no station announcements on some trains.

The 60 problems which were identified are distributed among 15 "requirements" along the trip. Of course, it must be noted that the problems also occur at locations other than those under which they are noted in the trip, but the requirements serve to alert the reader to the meaning of the problem.

The principal investigators next sought to identify potential solutions to the problems which had been isolated. The techniques used in this phase of the study were:

1) An exhaustive literature search for systems and/or devices which could solve the identified problems was conducted;

2) Consultants in transportation engineering and architecture met with with the principal investigators to discuss solutions which had been identified and to suggest alternatives;

3) Preliminary solutions were discussed at a national meeting of transit planners and architects representing 8 rapid rail systems as well as representatives of UMTA;

4) A survey of attitudes toward the proposed solutions was conducted on a sample of visually impaired travellers and on a sample of sighted travellers, in order to determine the anticipated benefits of the solutions as well as the possible hazards or inconveniences they might pose.

The results of this phase of the study show that many of the problems encountered by the visually impaired could be remedied 1) by low-cost minor modifications in transit stations and on trains (e.g., painting color-coded lines); 2) by consistently presenting information which is intended for regular presentation (e.g., announcement of stops); and 3) by compliance with existing standards for many fixtures and hazards (e.g., handrails, steps). Other, more elaborate solutions are discussed for the sake of planners who have the option of including various devices and designs in new stations and systems.

The reader may also wish to attend to the other two documents which resulted from this study, which are described below.

Volume II: Information About Visual Impairment for Architects and Transit Planners.

This document contains a) A Glossary of Terms Commonly Encountered in the Literature on Blindness and Orientation and Mobility; b) An Annotated Bibliography of Selected References on the Visually Handicapped; c) Considerations in the Design of Information Systems for Communicating with the Visually Handicapped; d) An Annotated Bibliography on the Use of Transit by the Blind; and e) Incidence and Demography of the Visually Impaired in the United States. The

document is designed to assist individuals who wish to design environments which will be free of barriers to the visually impaired.

Volume I: Solutions for Problems of Visually Impaired Users of Rail Rapid Transit

This document presents a detailed description of all project efforts, including those directed at identification of the problems and those directed toward solutions. Also included are several appendices which could be of value to other projects dealing with the visually impaired in rapid rail systems, such as a detailed task analysis of a trip through a hypothetical rapid rail system,and a review of all known devices and designs which could significantly affect the travel of blind users of rapid rail.

TECHNIQUES FOR IMPROVING COMMUNICATION WITH VISUALLY IMPAIRED TRAVELLERS IN RAIL RAPID TRANSIT ENVIRONMENTS

A. Introduction

The techniques included in this section are based on an extensive review of transit and blindness literature related to rail rapid transit and the visually impaired (see Volume I, Appendix I for a complete review), on results of perceptual research summarized in Information about Visual Impairment for Architects and Transit Planners (Vol. II of Improving Communications with the Visually Impaired in Rail Rapid Transit Systems), on formal and informal input and feedback from architects and transit personnel, and on reactions of consumers, both visually impaired and non-visually impaired.

The principal investigators of this project are confident that implementation of the techniques described here will result in more safe, efficient and pleasant rail rapid transit use by visually impaired persons. Some of the techniques are described as concepts only, and specifications are not given for their implementation. Further technical development and empirical evaluation needs to be conducted before more specific recommendations can be made. Where such development and evaluation are especially necessary, this is mentioned in the report.

This chapter is divided into four sections. Section B distills techniques described in Appendix I into brief and manageable form, and relates these techniques to specific problems reported by visually impaired travellers in Boston, Philadelphia and Atlanta and to problems related by orientation and mobility specialists.

Section C is a composite of those parts of the GSA Accessibility Standard, October 14, 1980, which are currectly in effect which related to rail rapid transit architecture and which the principal investigators consider appropriate considerations in designing environments which are accessible for visually impaired travellers.

Section D describes, on a conceptual level, navigational aids which could potentially guide visually impaired persons from station entrances to fare card machines and/or the fare barrier, then to the platform, and from the train to the station exit. These concepts include an auditory pathway and a tactile/visual path.

B. Suggested Techniques

The information below is a side-by-side presentation of problems identified by visually impaired users of rail rapid transit and techniques which the principal investigators of this project conclude would enhance rail rapid transit use for visually impaired persons.

The process used to obtain information regarding problems of visually impaired travellers is described in Chapter 4. Some of the techniques have been suggested by another or many other sources concerned with accessibility. Readers who wish a more elaborate presentation of potential solutions or who desire documentation of sources of particular suggestions should refer to Appendix I.

The decision to implement a particular technique should be based on a detailed analysis of all the sources of information which will be available to visually impaired travellers at each decision point on a trip in each system. In conducting the type of analysis included in Appendix D, separate consideration is made of the information needs of totally blind and low vision travellers. The analysis will indicate that some systems will be found to

have signage and graphics which are well designed for low vision persons, but this same system might have none of the information sources which are particularly needed by totally blind travellers at some points on trips. Therefore such a system would particularly need to consider techniques for aiding totally blind travellers.

Each authority planning to implement techniques to aid visually impaired persons should also consult with its special needs advisory committee to be certain that the selected techniques address problems pertinent to that system and to visually impaired users of the system.

I. Access to Station	I.
A. Requirement: User must identify the station and locate the entrance.	A.
1. Problem: There was a lack of consistent signage or architectural clues which could be used to find the entrance to some stations.	1. Logos A large, well-lighted logo could be placed as consistently as possible in relation to each station entrance. Consistent placement is difficult to achieve because of general considerations such as directions of pedestrian approach and angles of clear viewing, which are also important to low vision persons. Placement of a smaller version of the logo directly over each entrance would help resolve this difficulty. If letters are at least 16" high, they can be read at 20' by persons having vision no greater than 20/800. This includes the vast **majority** of visually impaired travellers.
II. Accessibility Within Station	II.
A. Requirement: User must perceive and understand information about the correct platform, train, and direction.	A.
1. Problem: Some signs were located too high or in inconsistent locations.	1. Sign placement Signs could be in consistent locations throughout a system. For example, entrance/exits may all have two line signs immediately above them. The top line may give the station name and the bottom line may give additional information such as the name of the line, the direction of travel, or the location of the station within the city. Platforms may all have signs 10'- 20' from the platform edge, 8' high, and repeated every 25'. Signs intended to be read at a distance need to be above head level so they are not obscured by standing persons. If signs placed at 8' high are printed in 4" letters, they will be legible at 10' to travellers with 20/400 vision under ideal viewing conditions. (They are clean, well lighted,

	of high contrast, and of matte finish.) Signs placed higher need to be larger to achieve the same level of legibility.
2. Problem: Some signs were poorly lit, which hindered attempts to read them.	2. Sign lighting Signs should be well lighted internally or externally, either directly or indirectly, whichever is the most consistent with overall station design. Signs having external illumination will be adequately lighted for most low vision travellers if illumination at the surface is fifty footcandles. The lighting should be positioned to eliminate glare and so that shadows will not be cast by viewers in different positions.
3. Problem: Some signs were dirty and/or defaced.	3. Sign cleanliness Regular station maintenance should include attention to signs.
4. Problem: Some signs had low contrast between print and background.	4. Contrast on signs Signs which are white or light on black or dark backgrounds will have the greatest legibility.
5. Problem: Some signs, especially glossy baked enamel ones, were difficult to read because of glare.	5. Matte finish Matte finish signs are less effected by glare.
6. Problem: Some signs were written in small print only.	6. Print size Signs to be read at a distance should be in large print. The table which follows suggests the functions of signs at various distances for an individual with 10/200 vision.

Estimated Use and Visibility of Signage for an Individual with Vision No Greater Than 20/400

Minimum Size	Maximum Viewing Distance	Use of Information
8 in.	up to 20 feet	station entrances
6 in.	up to 15 feet	station name line name along platform and at station entrance
4 in.	up to 10 feet	train name (viewed from platform)
3 in.	up to 7.5 feet	line transfer information inside station
2 in.	up to 5 feet	route information on display maps

Though population estimates are extremely crude, this table would at least take into account the visual requirements of at least 70 percent of the visually handicapped population.

7. Problem:
There were no large print maps.

7(a) Print display maps

Print display maps can be designed, produced, mounted and illuminated so that a majority of low vision persons can obtain information from them.

(1) Letters should be no smaller than 18 pt. type. They should adhere to the proportions given in 1190.200(c).
(2) Colors should contrast with one another in brightness as well as hue. Most important information should be in white or light colors. A black or dark background is preferred.
(3) Maps should have a matte finish.
(4) Maps should be mounted vertically, and so that users can read them from as close as 2 in., if required by their visual condition.
(5) Maps may be illuminated internally. If they are illuminated externally, the lighting should be positioned to eliminate glare and prevent casting a shadow by viewers at varied distances.

	7(b) Distributed maps Low vision persons can utilize large type system and route maps. If display maps are well-designed for reading by low vision persons, these same graphics can be used to print maps on matte-finish paper for distribution.
8. Problem: The contrast between color codes was too low to be useful as a clue on some signs.	8. Color contrast The greatest apparent contrast between colors will be achieved by selection of colors on the basis of contrast in brightness as well as in hue.
9. Problem: Poor lighting made maps and large print signs less distinguishable.	9. Lighting for maps Maps will be adequately lighted for most low vision travellers if they are lighted in the same way as signs. (See II. A. 2 above)
B. Requirement: User must be able to pass through doors.	B.
1. Problem: Doors which opened outward and were in the path of travel were dangerous obstacles which could be walked into.	1. Door positions Hinged doors, while not in active use, should always be in a fully open or fully closed position for best detection by visually impaired travellers.
C. Requirement: User must approach fare barrier/ticket booth.	C.
1. Problem: There was no standard location of the entry gate or turnstile, which made it difficult to locate the appropriate gate.	1. Location of fare barrier/ticket booth In new systems, standardization of location of these facilities will enable visually impaired travellers to find them, independently and efficiently, without needing to learn their varied locations in each station.
2. Problem: There was no textured or otherwise tactually discernable path to gate, which could be consistently used.	2. Path to fare barrier/ticket booth Either an auditory pathway or a tactile/visual pathway can provide continuous in-station guidance to such facilities. Descriptions of these concepts can be found in Section D of this chapter.

3. Problem: There were narrow turnstiles which were difficult to pass through with dog guides.	3. <u>Accessible gates</u> Visually impaired travellers may be permitted to use gates intended primarily for passengers in wheelchairs.
4. Problem: There was no standard location for the information/change booth.	4. <u>Location of information/change booth</u> See II, C, 1 and 2.
5. Problem: There was a lack of distinction between entry and exit turnstiles in some places.	5. <u>Distinction between entry and exit turnstiles</u> Entry and exit turnstiles can be distinguished by low vision travellers using a system of red and green (or white) lights above the turnstiles or by large print signs approximately 8' above floor level.
6. Problem: The section of the "handicapped gate" on which the user was supposed to push when buzzer sounded was texturally unmarked, and the traveller pushed on the area adjacent to the gate rather than on the gate itself.	6. <u>Tactile marking on handicapped gate</u> The appropriate section of the handicapped gate may be smooth and the surrounding structure rough. This is consistent with the interpretation of a rough door knob or handle indicating the entrance to a hazardous area. (See Section C of this chapter for the GSA standard concerning tactile warning identification.) The visually impaired person can safely push on a smooth handle, but should not push on a rough one.
D. Requirement: The user must manipulate currency or show "proof of payment."	D.
1. Problem: There were farecard machines in which the farecard had to be inserted in a unique manner.	1. <u>Fare card design</u> Fare cards or passes should be so designed that a tactual clue facilitates correct orientation for insertion. See Figs. 1 and 2.
2. Problem: There were coin or token slots which had no contrast to the rest of the fare collection device, which made finding the slot a matter of trial and error.	2. <u>Slot design</u> Slots for coins or cards should have a high contrast corder, so they can be easily located by low vision travellers. Slots for coins or cards should have a raised border so they can be easily located by blind travellers. These borders should be so designed that they guide the coins or cards into correct position.

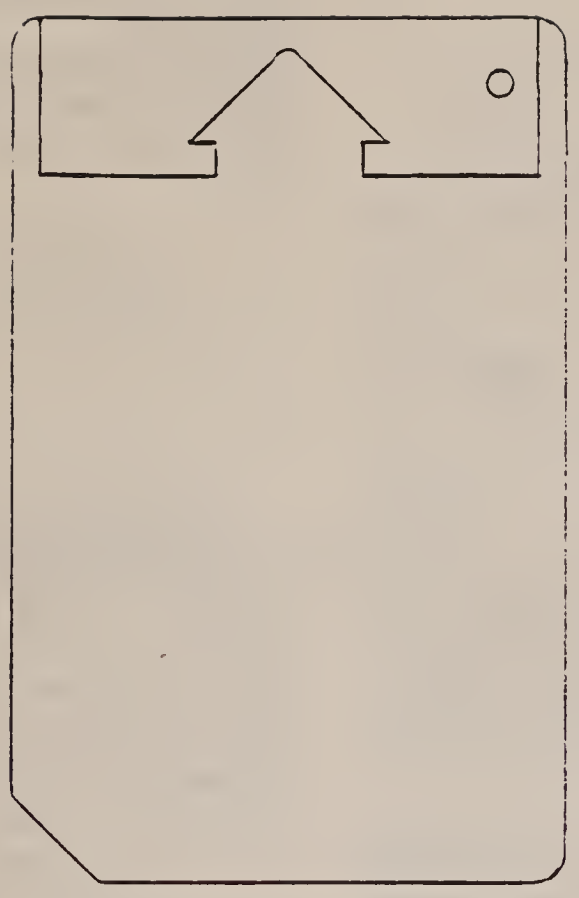

FIG. 1 FARE CARD, PATCO.
THE DIAGONAL CORNER ENABLES TACTILE ORIENTATION.

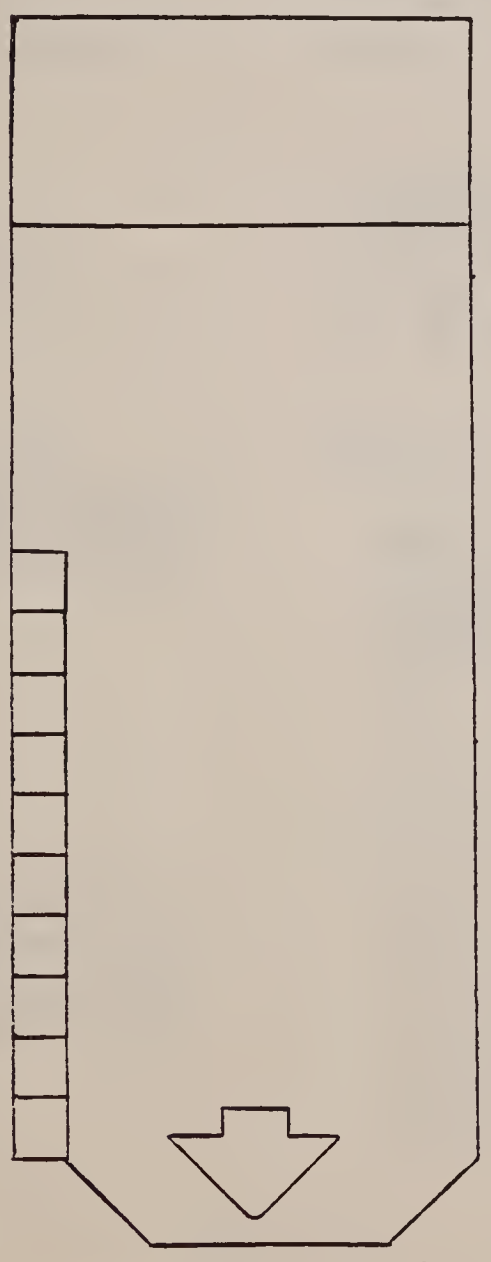

FIG. 2 FARE CARD, DANSKE STATSBANER.
TACTILE ORIENTATION IS MADE POSSIBLE BY THE DIAGONAL CORNERS AND THE CLIPPED SQUARES.

ONE SQUARE IS CLIPPED OFF EACH TIME THE CARD IS INSERTED INTO THE VALIDATING MACHINE.

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3. Problem: Narrow money slots were the only passage for voice communication with attendants in some places, which made conversation very difficult.	3. <u>Facilitating voice communication with attendants</u> Communication can be facilitated by larger openings for voice communication or by additional head level openings.
E. Requirement: The user must travel along the platform to wait for the train.	E.
1. Problem: There were station platform edges marked with badly faded painted lines which were not sufficiently distinct from their adjacent area.	1.2.3 <u>Platform edge marking</u> Platform edges can be marked by warning strips along the entire length of the platform which differ from the floor of the platform in both color and texture. Appropriate colors, textures, and dimensions for such warning strips are currently under investigation.*
2. Problem: There were station platform edges without guardrails.	
3. Problem: There were station platform edges with textured strips which were not of sufficient contrast to the adjacent area so as to serve as tactile warnings.	
4. Problem: There were repaired areas of pavement which were re-surfaced with textured material that gave false clues.	4. <u>Repaired pavement</u> Pavement repairs should not contrast in texture with surrounding floor area.

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* This research is being conducted by John Templer, Georgia Institute of Technology; Billie Louise Bentzen and Alec F. Peck, Boston College.

F. Requirement:
The user must be able to avoid hazards.

1. Problem:
There were cracks and breaks in the pavement which could cause falls.

F.

1. Repaired pavement
Pavement cracks or breaks, especially those having a vertical discontinuity of ¼" or more, should be promptly repaired.

2. Problem:
There were litter baskets in potential travel paths.

2. Placement of litter baskets
Moveable litter baskets should be placed away from travel paths. Litter baskets which are fixed should ideally be recessed into walls or grouped with other station furnishings so they are not encountered and negotiated as separate obstacles.

3. Problem:
There were benches in potential travel paths where other travellers could be touched by canes, which places the traveller in an awkward social situation.

3. Placement of benches
Benches should be placed away from major travel paths. They should ideally be recessed into walls. They may also be grouped with other station furnishings so they are not encountered and negotiated as separate obstacles.

4. Problem:
There were newspaper and display racks in potential travel paths.

4. Placement of newspaper and display racks
Newspaper and display racks should be placed away from major travel paths. They may be mounted on walls or grouped with other station furnishings.

5. Problem:
There were poles and columns in potential travel paths.

5. Poles and columns
(a) Poles and columns are familiar and necessary supporting structures in some station designs. Removal of these supports is not feasible; however, injury resulting from bodily contact will be less where corners are rounded and where structural materials are somewhat resilient or encased by resilient materials to a height of 7'.
(b) Supporting columns can serve as helpful orientation clues, especially where they are located a consistent distance from the platform edge and if they are rectangular, with the long sides of the rectangle parallel with the platform edge or with the main flow of pedestrian traffic.

6. Problem: There were protruding telephone stations which did not project low enough to be detected by a cane.	6. Design of protruding telephone stations Telephone stations should protrude no more than 4", unless the protrusion has its leading edge at or below 27" above the floor. (See Section C of this chapter for the relevant GSA standard).
7. Problem: There were visual construction warnings which were attached to sawhorses located in potential travel paths.	7. Placement of construction warnings Sawhorses which must be used as construction warnings in potential travel paths should have horizontal braces no more than 27" from the floor so that they can be readily detected by a cane. All types of construction warnings should surround the danger at a minimum distance of 4' allowing the visually impaired traveller safely to take one full stride forward after physically encountering and perhaps displacing the warning barrier.
G. Requirement: The user must negotiate vertical movement.	G.
1. Problem: There were escalators which can be especially difficult to board and exit under stressful conditions.	1. Alternative level changing facilities Stairs and/or elevators should ideally be provided adjacent to all escalators.
2. Problem: There were handrails which did not project beyond the tops or bottoms of stairs.	2. Handrail projections Handrails should project beyond the top and bottom of all staircases in stations. (See Section C of this chapter, for the applicable GSA standard.)
3. Problem: There were cluttered and littered stairs.	3. Cleaning stairs Regular station maintenance should include attention to stairs.
4. Problem: There was no high contrast warning strip on some stair edges.	4. Warning strips on stair edges (a) Stair nosings which contrast in color from the riser and tread help low vision persons judge the extent and dimensions of stairways. (b) Where it is difficult to provide contrasting stair nosings, visual judgement of the extent and dimensions of stairways can be enhanced by having the wall along the stairway contrast in color and brightness from the surrounding wall.

5. Problem: Glare from windows was found on stairs, which may suddenly deprive travellers of visual clues.	5. <u>Control of glare</u> Glare on stairs can be minimized by illuminating stairways for their entire length by either artificial or natural light, not a combination of the two.
6. Problem: There was no clear visual or textural marking which clearly indicated the top step, which in some cases was the sidewalk.	6. <u>Identification of top steps</u> Especially where station entrances consist of small open shelters with stairs in line with pedestrian traffic along a sidewalk, and leading directly down, a warning to visually impaired persons should be provided by both a distinctive color band before the top step and a tactile warning.
7. Problem: There were breaks in handrails at landings, which caused confusion when staircases were unopposed.	7. <u>Continuous handrails</u> Continuous handrails at landings give visually impaired travellers information about the direction of stairs following landings. (See Section C of this chapter for the applicable GSA standard.)
8. Problem: There were greasy, filthy handrails which made use of the rail undesirable.	8. <u>Clean handrails</u> Routine maintenance should include attention to handrails.
H. Requirement: The user must identify the correct train.	H.
1. Problem: There were no train announcements (name or destination) in stations.	1. <u>Train announcements in stations</u> In-station announcements identifying arriving trains enable visually impaired travellers to independently identify an arriving train without being able to see a sign on the train or needing to ask fellow travellers to confirm the identification of the train.
2. Problem: There were trains which sat silently in stations, and they could not be recognized until their doors closed.	2. <u>Train departure announcement</u> Whenever feasible, the departure of a train should be announced a few seconds prior to departure. If personnel in the vicinity of the train are cognizant of the problem of visually impaired travellers, they can ensure that they are made aware of the waiting train.

I. Requirement: The user must observe and approach the train door area and enter the vehicle.	I.
1. Problem: The open doorway could not be quickly located.	1. <u>Auditory beacon</u> Chimes, bells, buzzers, or other sound generators could be located immediately above doors to signal their presence for blind travellers. The appropriate characteristics of such tones, however, should be locally determined prior to installation, since unique acoustical environments may effect their value.
2. Problem: There were open spaces between cars on trains which were mistaken for doors.	2. <u>Gaps between vehicles</u> Design of newer trains commonly eliminates this problem by providing some kind of framework which nearly fills this space and which is close enough to the platform edge to be readily contacted. Some older trains have been retrofitted with expansion gates which serve the same purpose.
3. Problem: The gap between the platform and train presented a stumbling hazard.	3. <u>Platform/vehicle gap</u> Several concepts for closing this gap have been presented elsewhere. See Vol.I "Solutions for Problems of Visually Impaired Users of Rail Rapid Transit," Appendix I. These are concepts only, and need to be developed and tested before their implementation can be recommended.
III. Access Within the Vehicle	III
A. Requirement: The user must identify a vacant seat.	A.
1. Problem: There were no designated seats on some trains, which should be designated near the door of the train.	1. <u>Priority seating</u> Designated seats for handicapped passengers should be provided in consistent positions near the doors of all trains.

B. Requirement: The user must move along the aisle, possibly during train movement, or must ride standing.	B.
1. Problem: Packages were placed in aisles by passengers, which were obstacles and which gave misleading clues.	1. Passenger awareness Public awareness of the difficulties visually impaired persons have perceiving and negotiating around low and unexpected obstacles will help alleviate this problem.
2. Problem: There was a lack of standard locations (among trains) of posts for grasping to maintain balance.	2. Location of stanchions Straps or handrails or posts for personal support should be provided immediately inside the door on board trains and at frequent and consistent intervals along the length of the inside of the car.
3. Problem: No auditory warning was given before the train accelerated or decelerated to a halt.	3. Auditory warnings If possible, auditory warnings in the form of verbal messages could be given on board trains immediately before acceleration to high speeds and immediately prior to rapid deceleration.
C. Requirement: The user must identify the desired stop or station.	C.
1. Problem: There were no station announcements on some trains.	1. On-board announcement of stations Clearly understandable announcements of the name of the next stop enables visually impaired travellers to prepare to exit vehicles efficiently.
2. Problem: There were no tactile maps available.	2. Tactile maps Tactile maps are a satisfactory means of supplying system and route information to totally blind travellers if they are available for distribution to these persons.

D. Requirement: The user must be able to exit the vehicle.	D.
1. Problem: There was no forewarning of the side of the car on which doors would open for exit.	1. Auditory signals (a) An auditory signal device such as a buzzer or bell, located immediately above each door which would open, and which was activated 3 to 5 seconds before a train door opened, would be of great value in localizing the correct exit and preparing to disembark. (b) Alternatively, where there is on-board announcement of stations, the announcement can include the side of the train on which doors will open.
IV Accessibility Upon Leaving the Station	IV
A. Requirement: The user must be able to exit the station.	A.
1. Problem: Some ends of platforms were not adequately blocked, and could be fallen off while other cues were being attended to.	1. Platform end barriers Ends of platforms should be physically blocked by barriers at least 2 to 3 feet in height, which cannot be upset or broken by accidental contact.
2. Problem: Some exit turnstiles were made of floor-to-ceiling horizontal bars, which were dangerous when in motion.	2. Accessible exits An accessible exit gate which can be passed through quickly and safely should be provided at all platform exits. GSA standards do not consider these exits made of floor-to-ceiling horizontal bars to be accessible. (See Section C of this chapter.)
3. Problem: Walls made of bars rather than being solid led to inappropriate auditory localizing, because of the irrelevant and confusing sounds from the other side of the barrier.	3. Solid walls Solid barriers provide auditory cues which are more easily used. Where see-through walls are desirable, the use of transparent solid materials such as glass or clear plastic is preferable to the use of bars or chain link fence.

4. Problem: There were "blind alleys" which were unmarked or only marked with visual signs.	4. <u>Auditory or tactile path</u> See Section D of this chapter for a description of the conceptual "Auditory Path" and "Tactile Path", either of which would be applicable to this problem.
V. Systemwide Problems of a General Nature	V.
1. Problem: Route information available by telephone was incomplete or was not informationally expanded for blind users (eg. number of stops between entry and exit stations was not available.)	1. <u>Telephone information system</u> A telephone information system which provided information on variables such as the number of stops between stations, the level on which entry and exit stations were located, and the location of transfer stops (where applicable) would be of great value to visually impaired persons.
2. Problem: Rest rooms were not available in some stations.	2. <u>Rest room availability</u> The availability of clean rest rooms is a great comfort to all travellers, especially in personal emergencies.
3. Problem: Rest rooms were locked and/or unmarked in some stations, and attendants who could open the door were difficult to find.	3. <u>Rest room access</u> Rest rooms which are marked with raised large print signs can be located by many visually impaired travellers. In situations where attendants must be located to unlock doors, instructions for locating the attendants could be available, in raised large print, on the door or immediately adjacent to it.
4. Problem: There were no raised letters or braille signs to identify such places as rest rooms.	4. <u>Large print signs</u> Where rest rooms are marked by signs, raised large print should be used. Braille signs offer another alternative for some blind persons.
5. Problem: There were no auditory cues to beckon travellers to safe exits in an emergency.	5. <u>Auditory emergency exit indicators</u> Speakers located immediately above station exits, which could broadcast messages such as "This is a safe exit" during an emergency, would be advantageous to all travellers under certain conditions (e.g. smoke-filled station).

C. GSA Accessibility Standards Relevant to Accessibility for Visually Impaired Travellers on Rail Rapid Transit

Transit authorities have been responsive to the needs and problems of many handicapped travellers for some time. Adherence to GSA Standards (or to ATBCB or ANSI standards) has solved some potential problems of visually impaired users of rail rapid transit in the three cities surveyed.

We are including here those sections of the GSA Accessibility Standard, Oct. 14, 1980, which pertain to increased accessibility for visually impaired persons in rail rapid transit. Because transit has been cognizant of these standards for some time, problems associated with failure to adhere to these standards were not necessarily reported in our data collection.

The principal investigators endorse the concepts contained in the following standards. They have not conducted research to validate specific dimensions contained in the GSA Standards, but know of no reason to believe the dimensions given are inappropriate.

5. BUILDINGS

5.1 RAMPS

5.1.7 Edge Protection. Ramps (with the exception of curb ramps) and landings with vertical drop-offs greater than 6" shall have curbs, walls, railings or projecting surfaces to prevent people from slipping off the ramp.

5.3 DOORS AND DOORWAYS

5.3.2 Revolving Doors and Turnstiles. Revolving doors and turnstiles are not considered accessible entrances. Accessible doors shall be located within 20 feet, or preferably, adjacent to either of these elements.

5.4 STAIRS

5.4.2 Treads and Risers. All steps on a single flight of stairs shall have uniform riser heights and uniform tread widths. Open riser stairs are not permitted.

5.4.4 Handrails. Continuous handrails shall be provided at both sides of all stairs.

Handrails shall extend a minimum of 12" on one side beyond the top riser and 12" plus the width of one tread on one side beyond the bottom riser. At the top, the 12" extension shall be parallel with the floor. At the bottom, the handrail shall continue to slope for a distance of one tread width from the bottom riser with the 12" remainder being horizontal and parallel with the floor.

5.4.5 Overhead Clearance. A protective barrier or warning signal shall be provided wherever an accessible path or space under a stairway has a headroom clearance less than 80".

5.8 PUBLIC TELEPHONES

5.8.3 Clearances. Telephones shall have an unobstructed floor approach space of at least 30" x 48".

Telephones, telephone enclosures, telephone booths and seats shall not reduce the minimum clear width of accessible paths of travel. (See also Section 5.13.2, "HAZARDS".)

5.9 ELEVATORS

5.9.1 * Elevators shall conform to the latest version of ANSI A17.1, "Safety Code for Elevators" and the "Suggested Minimum Passenger Elevator Requirements for the Handicapped" as developed by the National Elevator Industry, Inc. (Relevant portions of this latter document are included in this chapter following the relevant portions of the GSA Standards.)

5.11 SIGNAGE

5.11.1 General. Signage at entrances to accessible rooms and public spaces, specifically permanent room numbers and permanent space titles, shall comply with the criteria specified within this section.

5.11.2 Room/Facility Identification. Letters, numbers and symbols on signs shall be raised or incised 1/32" minimum, with sans serif characters and sharply defined edges. The characters shall be between 5/8" and 2" high with a width to height ratio of between 3:5 and 1:1. Indented Characters shall have a minimum stoke width of ¼" and be so proportioned so as to assure proper legibility (width to height ratio between 1:5 and 1:10).*

5.11.3 Location. Character identification shall be mounted at a height of 54" to 66" above the floor, and wherever possible, mounted on the wall at the latch side of the door.

5.11.4 Color Contrast. Characters shall contrast with their background, preferably light characters on a dark background.

5.11.6 Tactile Warning Identification. Doors leading into hazardous areas that might prove dangerous to a blind person shall be made quickly identifiable to the touch by knurling, roughening, or applying an abrasive coating to the surface of the door handle, knob, pull or other operating hardware.

Tactile warning indicators shall not be used to identify exit stairs.

5.12 FIRE ALARM SIGNALS

5.12.1 General. An audible fire alarm signal shall be provided in buildings which require fire alarm systems. Visual alarms are not required, except where an Occupant Emergency Organization plan has not been established to assure the safe evacuation of handicapped persons. Where visual alarms are needed, they shall be capable of simultaneous activation, and adequately meet the safety needs of all occupants whether visually or audibly handicapped.

* The principal investigators of this project do not consider incised characters sufficiently legible to be used for this purpose.

5.13 HAZARDS

5.13.1 Overhead Clearance. A minimum vertical clearance of 80" shall be provided above all accessible paths of travel.

5.13.2 Clear Width. Side protrustions under no circumstances shall reduce the minimum clear width of accessible paths of travel.

Side protrustions are restricted to 4", unless the protrustion has its leading edge at or below 27" above the finished floor/ground or is protected by wing walls or located within an alcove.

The following sections are taken from "Suggested Minimum Passenger Requirements for the Handicapped", which is Appendix "A" of GSA Accessibility Standard, October 14, 1980.

Suggested Minimum Passenger Elevator Requirements
for the Handicapped

7. CAR CONTROLS

Controls shall be readily accessible from a wheelchair upon entering an elevator.

The centerline of the alarm button and emergency stop switch shall be at a nominal (35) inches and the highest floor buttons no higher than (54) inches from the floor. Floor registration buttons, exclusive of border, shall be a minimum of (3/4) inch in size, raised, flush or recessed. Visual indication shall be provided to show each call registered and extinguished when call is answered. Depth of flush or recessed buttons when operated shall not exceed 3/8".

Markings shall be adjacent to the controls on a contrasting color background to the left of the controls. Letters or numbers shall be a minimum of (5/8) inch high and raised or recessed .030 inch.

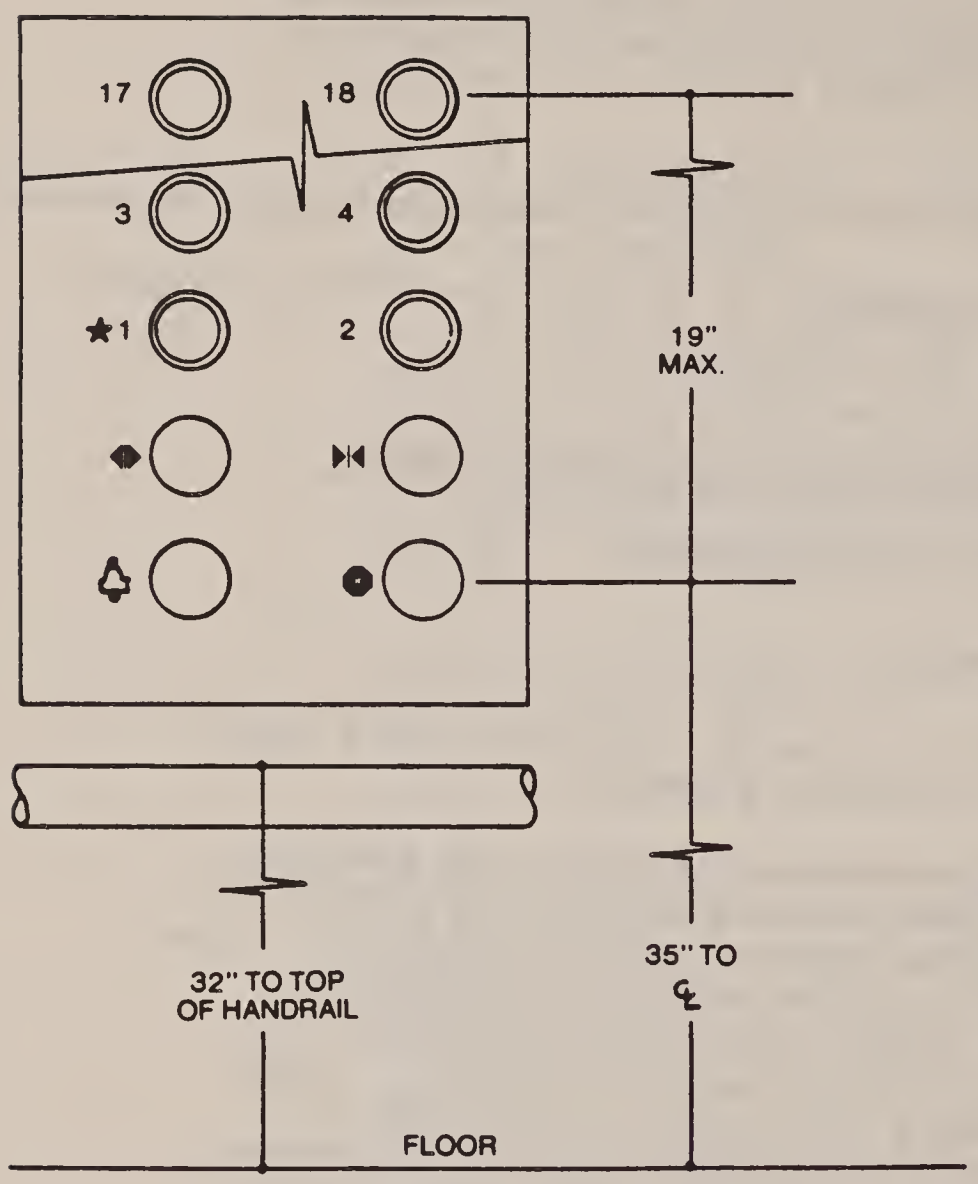
Applied plates permanently attached shall be acceptable.

Emergency controls shall be grouped together at the bottom of the control panel.

Symbols as indicated shall be used to assist in readily identifying essential controls.

Controls not essential to the automatic operation of the elevator may be located as convenient.

NOMINAL = ± 1 Inch.



CAR CONTROL SYMBOL DESIGNATION

DOOR OPEN

DOOR CLOSE

AUDIBLE SIGNALING DEVICE (ALARM)

EMERGENCY STOP SWITCH

Identify the main floor by use of the following symbol:

(Symbols shown are ⅝" actual size)

8. CAR POSITION INDICATOR & SIGNAL

A car position indicator shall be provided above the car operating panel or over the opening of each car to show the position of the car in the hoistway by illumination of the indication corresponding to the landing at which the car is stopped or passing.

indications shall be on a contrasting color background and a minimum of ½ inch in height.

In addition, an audible signal shall sound to tell a passenger that the car is stopping or passing a floor served by the elevator.

Special button located with emergency controls may be provided. Operation of button will activate audible signal only for desired trip.

9. TELEPHONE OR INTERCOMMUNICATING SYSTEM

A means to two-way communication shall be provided between the elevator and a point outside the hoistway in accordance with the requirements found in the latest edition of ANSI A17.1.

If a telephone is provided, it shall be located a maximum of (54) inches from the floor with a minimum cord length of (29) inches.

Markings or the international symbol for telephones shall be adjacent to the control on a contrasting color background. Letters or numbers shall be a minimum of (5/8) inch high and raised or recessed (.030) inch. Applied plates permanently attached shall be acceptable.

13. HALL BUTTONS

The centerline of the hall call buttons shall be a nominal 42 inches above the floor. The button designating the UP direction shall be on top.

Direction buttons, exclusive of border, shall be a minimum of (3/4) inch in size, raised, flush, or recessed. Visual indication shall be provided to show each call registered and extinguished when the call is answered. Depth of flush or recessed buttons when operated shall not exceed 3/8".

14. HALL LANTERN

A visual and audible signal shall be provided at each hoistway entrance indicating to the prospective passenger, the car answering the call and its direction of travel.

The visual signal for each direction shall be a minimum of 2½ inches in size and visible from the proximity of the hall call button.

The audible signal shall sound once (1) for the up direction and twice (2) for the down direction.

The centerline of the fixture shall be located a minimum of (6) feet from the floor.

The use of in-car lanterns conforming to above and located in jamb shall be acceptable.

15. DOOR JAMB MARKING

The floor designation shall be provided at each hoistway entrance on both sides of jamb visible from within the car and the elevator lobby at a height of (60) inches above the floor. Designations shall be on a contrasting color background (2) inches high and raised (.030) inch.

Applied plates permanently attached shall be acceptable.

D. Pathway Solutions

A ideal solution to many of the information gathering problems of the visually impaired in rapid rail systems would be a pathway which led them safely and efficiently from a station entrance, through the system, to a station exit. Although the authors know of no such pathway currently in existence in a rapid rail station, two such pathways are described, on the conceptual level, below.

1. Auditory Pathway

One solution to many of the problems encountered by visually impaired users of rail rapid transit would be the presence of a system of electronically-activated spoken messages which would guide the user through the rapid rail system. The user would carry a pocket-sized, lightweight device which would

be capable of activating units that played recorded messages (or synthetic speech) which presented route directions. These units would be located at various key locations within stations and on board trains, and would supply all necessary information for orientation of the traveller. Figure 3 depicts an artist's conception of such an "auditory pathway."

It should be noted that the auditory pathway would also be usable by other members of the elderly and handicapped population, including non-readers, mentally retarded citizens, and elderly citizens who become easily confused in transit stations. It could also be programmed in more than one language, enabling use by non-English speaking users.

2. Tactile Pathway

Another pathway which would be of value to visually impaired travellers would be a continuous textural path which was composed of material sufficiently distinct from the surrounding surface so as to be easily detected under foot or by cane. Such a path would begin at the station entrance, would pass through necessary turnstiles and/or gates, and would terminate at the platform. It would be marked by characteristics which distinguished it from a similar path which led from the platform to the exit.

Such a path could also be colored so as to have high visual contrast to the surrounding surface. This would be an aid to low vision persons whose residual vision was sufficient to allow them to visually follow the path.

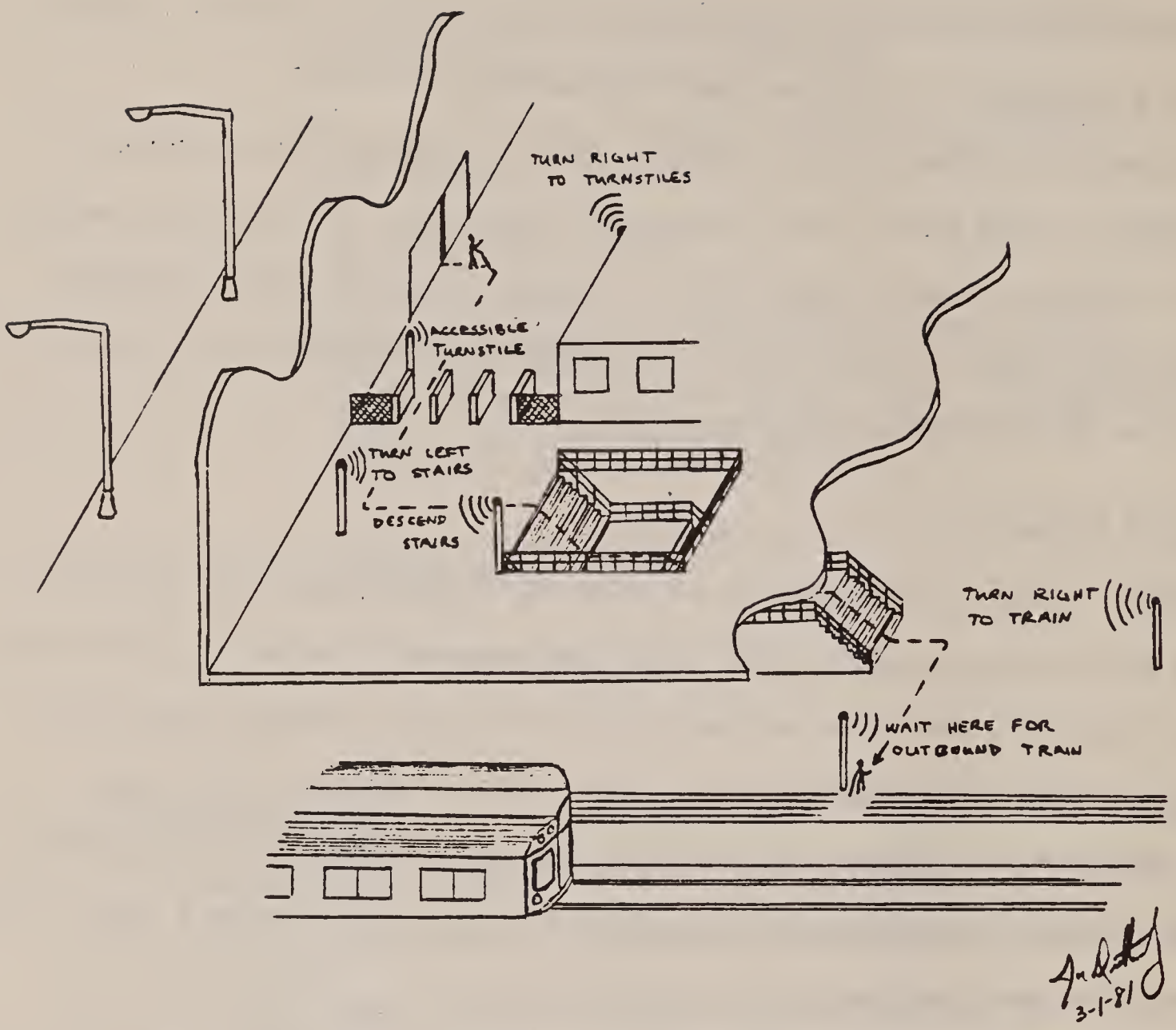


FIG.3 ARTIST'S CONCEPT OF AN AUDITORY PATHWAY IN A RAPID RAIL STATION.

HV1708 Bentzen, Billie L; Richard c.1
B446 M. Jackson & Alec F. Peck.
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